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SOME FEATURES OF THE WORKS OF THE MONTREAL WATER AND POWER COMPANY[1]

By F. H. Pitcher[2]

The Montreal Water and Power Company was organized in 1891 for the purpose of furnishing a water supply to the outlying municipalities of the City of Montreal and developing electric power. These municipalities were disposed in a ring around the city proper and extended from the St. Lawrence River at a point west of the City going north and east to a point on the river east of the City. A line drawn through their center forms an approximate semi-circle having a length of 10 miles, as shown in figure 1. The total area of this territory is approximately 17.5 square miles.

These municipalities, as they were then called, were independent communities having their own municipal Council, borrowing power etc., like any other village or town. Most of them had, at that time, no public water supply of their own. They took water for the supply of their small distribution systems from the City of Montreal by large meters. The City of Ste. Cunegonde on the west was an exception. This municipality had its own pumping plant and furnished water to the Town of St. Henry by large meters. All the rest were receiving their supply through large meters from the City of Montreal.

The rates for water so furnished were high, 40 cents to 75 cents per 1000 imperial gallons being charged by the city, the supply was unsatisfactory and the scheme not sufficiently comprehensive to allow normal development of vacant property within the municipalities. The company, then, by undertaking the responsibility of the supply at reduced rates and extensive pipe laying ahead of immediate requirements, was enabled to obtain long term franchises from practically all of them and amalgamate them into a unit water

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[1] Read before the Montreal Convention, June 22, 1920. Discussion is invited and should be sent to the Editor.

[2] General Manager and Chief Engineer, Montreal Water and Power Company.

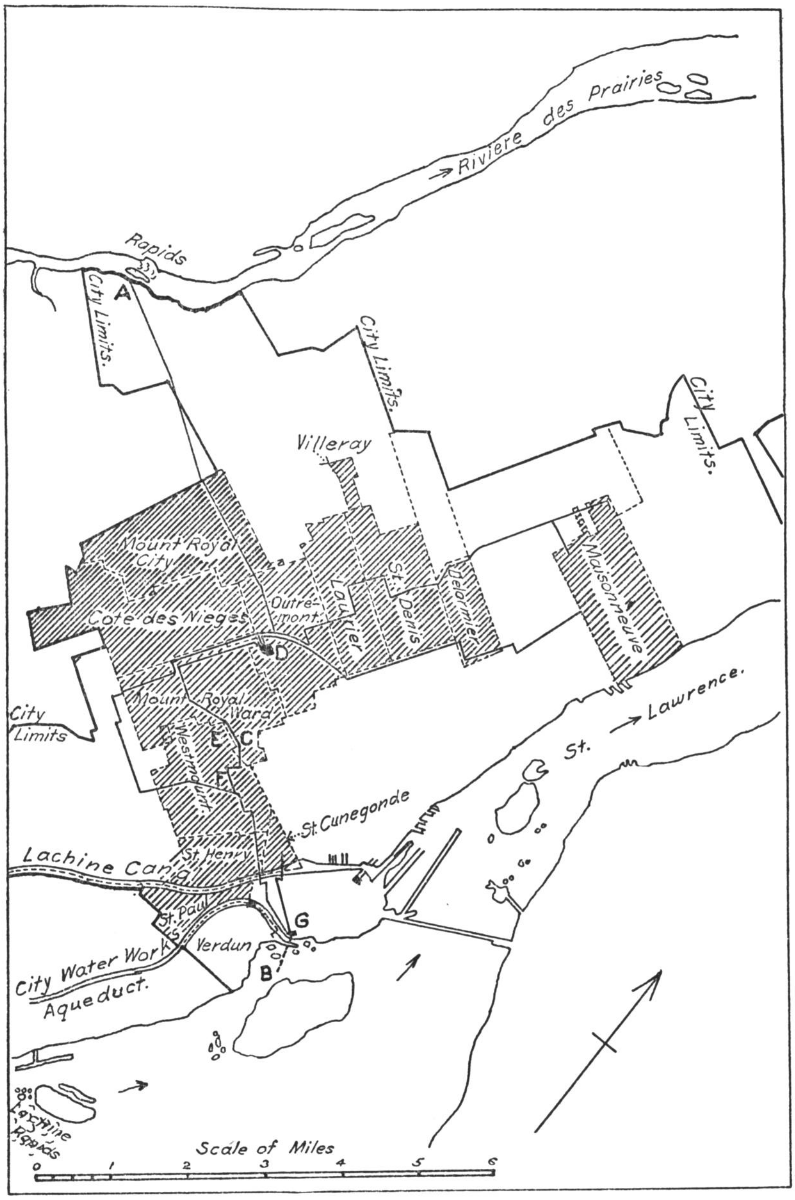

FIG. 1. DISTRICTS SERVED BY THE MONTREAL WATER AND POWER COMPANY

works system. It is believed that this enterprise more than any other has been responsible for the extraordinarily rapid growth of the outlying municipalities of Montreal.

Starting from the west and going north and east around the semicircle, these municipalities were then called the Town of Verdun: the Town of Cote St. Paul: the City of Ste. Cunegonde: the Town of St. Henry: the Village of Turcot: the Town of Cote St. Antoine: the Town of Notre Dame des Neiges: the Town of Cote des Neiges: the Village of Outremont: the Village of St. Louis du Mile End: the Village of Villeray: the Town of Cote St. Louis: the Town of Delormier: and the Town of Maisonneuve. These fourteen municipalities had, at that time, a total population of 30,000 approximately.

Since then, all, with the exception of the Town of Verdun, the Town of Cote St. Antoine, and the Village of Outremont, now respectively the Cities of Verdun, Westmount and Outremont, have been annexed to the city and form various wards and parts of wards of that corporation. Their aggregate population is today over 300,000 and approximate mileage owned by this company is 190.

The company still supplies all of the above with the exception of Verdun and Delormier, which were on a wholesale meter basis, where the contracts have expired, and Turcot Village, which is now a part of Notre Dame de Grace Ward. With the exception of Villeray and the Town of Cote des Neiges, all are supplied under a franchise system; the company owning the pipes and entire water plant and collecting the water rates. The two exceptions are supplied wholesale by meter connections to their own distribution systems. Recently the company has obtained a contract for the supply of the new Town of Mount Royal or Model City. This is also wholesale and on a meter basis, the town owning and administering its own distribution system.

The original idea was to supply all this territory from what is called Back River at point *A* on figure 1. The company had obtained a water power site there and the pumping was to have been done by hydraulic power. Electric power development was also contemplated. For various reasons this scheme was abandoned and the point of supply fixed at the present location on the St. Lawrence River near the head of Nuns' Island, at the point *B* on the plan.

An unusual feature of the system of the company is the extreme variation in elevation of the territory to be supplied. About 10 per cent of the territory is at an elevation of 30 to 40 feet, City datum, called the low level (St. Paul, St. Henry and Ste. Cunegonde); 25 per cent in the slopes of the mountain (Westmount, Cote des Neiges and Outremont high levels), called the high level; the remaining 65 per cent at an elevation of 150 to 225 feet, city datum, called the intermediate level. This latter level also includes Maisonneuve, part of which lies below 50 feet elevation but owing to its location is supplied through the intermediate system.

Included in the high-level territory is a small but rapidly growing community situated near the top of the Westmount Mountain, which is supplied by a third pumping plant delivering water at an elevation of about 600 feet and called the Mountain System. As will be seen, the levels vary between that of the river to about 600 feet above the same. By far the greater proportion is at the intermediate elevation.

Reservoirs have been built at 470 feet elevation on Cote des Neiges Road at *C* on figure 1 and at 360 feet elevation in Outremont at *D* figure 1, also shown in figure 2. The former has a capacity of 7,500,000 imperial gallons and the latter 45,000,000 gallons. There is a small tank of 60,000 gallons on the top of the Westmount Mountain at a point *E* on the plan, regulating the supply of the Mountain System.

The water is pumped from the clear water basin of the filter plant at the Main Station, *G*, figure 1, foot of Charlevoix Street, by two systems of pumps working at different pressures. For the low level there are 7,500,000 gallons electric turbine pumps in duplicate operating at 100 pounds pressure pumping direct without a reservoir. Automatic valves, connected with the Outremont Reservoir, are provided for emergencies.

For the intermediate, high and Mountain System supplies, there are in all at this station five electric turbine pumps having a combined capacity of 54,000,000 gallons and operating at 200 pounds per square inch. In addition, there is a steam reserve plant, consisting of boilers, etc., and steam turbine pump having a capacity of 15,000,000 gallons per 24 hours for this service.

On Clarke Avenue, Westmount, at the point *F* on the plan and at an elevation of 200 feet, city datum, there is a booster station taking water by a connection from the steel main at a pressure of

80 pounds and raising it to the reservoir in Cote des Neiges Road to an elevation of 470 feet. This station is equipped with two electric turbine pumps of 6,000,000 gallons capacity each and a small reserve steam installation.

At the Cote des Neiges Reservoir, at point *C* on the plan, there is a small pumping station having three electric turbine pumps and one gasoline reserve turbine pump, the combined capacity of which is 2,000,000 gallons. This station takes water from the reservoir and raises it to 610 feet elevation for the Mountain System.

The distribution systems at the various levels are connected to the different rising mains. At certain points it has been found necessary to introduce reducing valves rather than further to subdivide the pumping levels.

Main pumping station. This is located on the original site of the old Ste. Cunegonde water works at point *G* on the plan, which the Company acquired in 1891. It then consisted of an old steam pumping plant intake and a 12-inch force main about one mile long, running through Ste. Gabriel Ward of the city, crossing the Lachine Canal and supplying the former City of Ste. Cunegonde. This corporation also furnished the water supply of the adjoining City of St. Henry.

The first electric pumping installation of the Montreal Water & Power Company was made in 1898 at the site of this old pumping station and consisted of an electrically driven reciprocating pump of 5,500,000 gallons capacity. This was driven by a synchronous electric motor of 400 horse power through spur gears. Later in 1903 another similar unit of about the same capacity was installed. These pumps becoming obsolete have been abandoned and disposed of.

At the same time the force main capacity to the upper and lower levels was increased by adding 24-inch and 16-inch cast iron mains.

About this time the intermediate territory commenced to fill up, the distribution systems having been proceeded with from 1898.

More pumping and force main capacity becoming immediately necessary, a 15,000,000 gallon electric turbine pump was added and a 36-inch steel main 7½ miles long running around the Mountain to the Outremont Reservoir site was constructed, and there connected to the intermediate distribution system in Outremont and territory to the northeast. Pending the construction of the Outremont Reservoir, it became necessary to add a 15,000,000-gallon steam reserve. This consisted of a 1500-horse power steam turbine driving a single-stage turbine pump to operate at a maximum of 200 pounds pressure. Water-tube boilers, boiler house, chimney, and all accessories were installed and ready for operation in 1908.

A new 5-foot steel intake, taking water higher up and further out in the river had been installed just prior to the installation of the reserve steam plant.

Later three 10,000,000-gallon electric turbine units and one 7,000,000-gallon unit were added. In all, there are today on the intermediate service, turbine pumps having a combined capacity of 69,000,000 gallons per 24 hours, including the steam reserve.

The old geared pumps working on the low level, proving uneconomical on account of cost of repairs, have been superseded by the 7,500,000 gallon electric turbine pumps above mentioned.

Before the installation of the filter plant, the suction of the plant was 10 to 20 feet and it was found impossible to keep the impellers in the turbine pumps. Many different designs and various materials were tried but rapid pitting and hence destruction of the impellers invariably occurred. After the filter plant was put into operation and with the consequent decrease in the suction lift, this trouble disappeared. The low lift turbine pumps in the main station, which take water from the river, have been set at a low level in order to obviate this difficulty.

Each turbine pump has been provided with a separate Venturi meter. The cost per water horse power at the mains, including all pumping charges, maintenance of buildings, engineering and other overhead costs, but not interest or depreciation, is $60.60 per annum.

Filter plant. In 1909 and 1910, the company made the necessary arrangements with certain municipalities for the supply of filtered water and in 1912 the present filter plant was put into operation. This is of the well-known type of rectangular concrete construction operating at the rate of about 125,000,000 imperial gallons per acre per day. It has the usual negative head control, hydraulic operating tables, etc.

The coagulation period is one hour. This might have been longer, as in the Spring and Fall difficult water of high color and low alkalinity is treated. However, the characteristics of the effluent have always been maintained at a satisfactory limit.

Originally this plant was provided with the usual hypochlorite plant for final sterilization but during the war an electrolytic chlorine plant[3] was installed which proves much more satisfactory both in cost of operation and quality of effluent.

Chlorine gas, including all charges, is produced at less than 9 cents per pound and the installation has paid for itself twice over.

Just previous to the installation of the chlorine gas plant an alum plant[4] was added, the war interfering to such an extent in the price and the supply of alum that it became necessary to make it at the plant.

Bauxite and sulphuric acid in the requisite proportions are mixed and allowed to solidify in a concrete tray. The resulting crude alum is used exactly as was the refined product obtained before. This costs the Company $30.00 per ton today, all charges paid, and has resulted in a very considerable saving. Its manufacture, is, however, a horribly messy job. It would be desirable to provide special and separate buildings for it.

The present capacity of the filter plant is about 25,000,000 imperial gallons in 24 hours. Provision has been made in its design for doubling its capacity. When the enlargement is undertaken it is the intention to correct the matter of the coagulation period and to make other minor improvements.

Clarke Avenue Station. At one time prior to the installation of the main around the Mountain and the building of the Outremont Reservoir, this station handled all the water for the high, intermediate and Mountain System levels. The overflow from the low level entered a catch basin at this point, from which the pumps took their suction and delivered the surplus into the Cote des Neiges Reservoir.

At this time the station was equipped with about 12,000,000 gallons capacity in electric turbine units and about 10,000,000 steam reserve.

Today it handles only the water for the high levels and the mountain system and does this with 6,000,000-gallon electric turbine pumps in duplicate and a 3,000,000-gallon steam reserve.

Mountain System Station. The plant has been gradually increased to meet the demand and with the small storage capacity provided on the Westmount Mountain, economical operation has so far been realized.

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[3] See JOURNAL, September, 1917, page 337.

[4] A paper by James O. Meadows on this plant was read at the Montreal Convention and is printed in this number of the Journal.

Motive power. Under normal conditions all pumping is done by electric power purchased under contract from an outside supply company. The price of power, conditions of service, together with the force main and reservoir capacity provided, have given fairly satisfactory operating conditions up to the present time.

Difficulties of operation. The extremes of temperature met with are the source of special difficulties in the operation of water works in this locality. All main pipes and services installed by the Company are laid with a minimum cover of 5½ feet, which is sufficient to protect them from frost under conditions ordinarily met with. There have been, however, two exceptionally severe winters recently, 1917–18 and 1919–20, the intervening winter 1918–19 having been on the other hand exceptionally mild.

In both of the former years, long continued cold weather occurred before any protection from snow fall was obtained. The result of this was that the frost penetrated much deeper than usual, and in localities where the pipes were laid in gravel or rock-filled cuts, the frost reached a point 7 feet below the surface, and in one extreme case was found during last winter over 8 feet deep. The trouble was noted especially where pipes or hydrants were situated near sewer manholes or gullies. These, being without the protection of snow, permitted the frost to reach points which had not been affected in previous years.

The growing practice of clearing snow off the streets and sidewalks is also responsible for increasing trouble from frost. This constitutes a serious menace, for even in the construction of new services, it is useless to provide greater depth of cover when the connection to the main must be made at the old depth. The chief trouble from frozen pipes, however, occurs on the branches between the street line and the building served. This part of the pipe is laid by proprietors and is not under the control of the company. These services are frequently placed under walks which are kept cleared of snow and in many cases pass below depressed entrances to basements, leaving them with from 1 to 3 feet cover.

The enhanced cost of calling in a plumber today has led the consumer to rely more and more on the company for thawing out such services. This is done by means of electric current, passed through the pipe long enough to heat it and free it from frost. Current was formerly obtained for this purpose from the local power company by means of transformers connected to the 2200-volt mains and delivering about 400 amperes at about 50 volts.

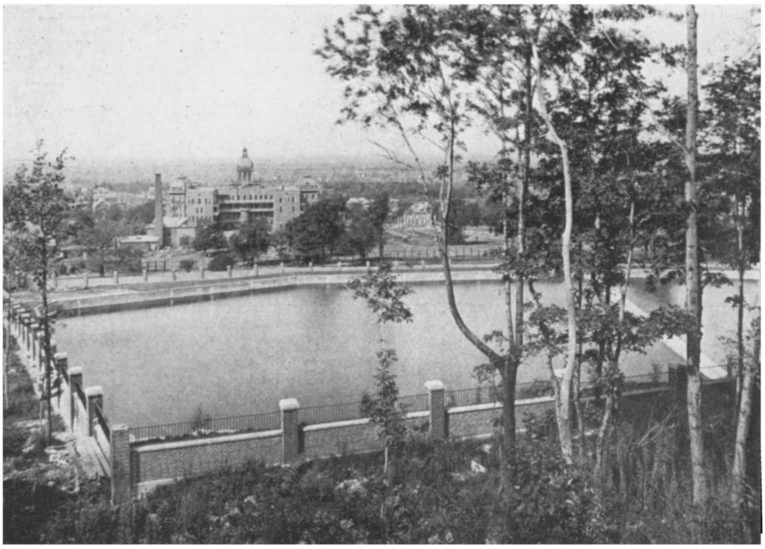

FIG. 2. THE OUTREMONT RESERVOIR

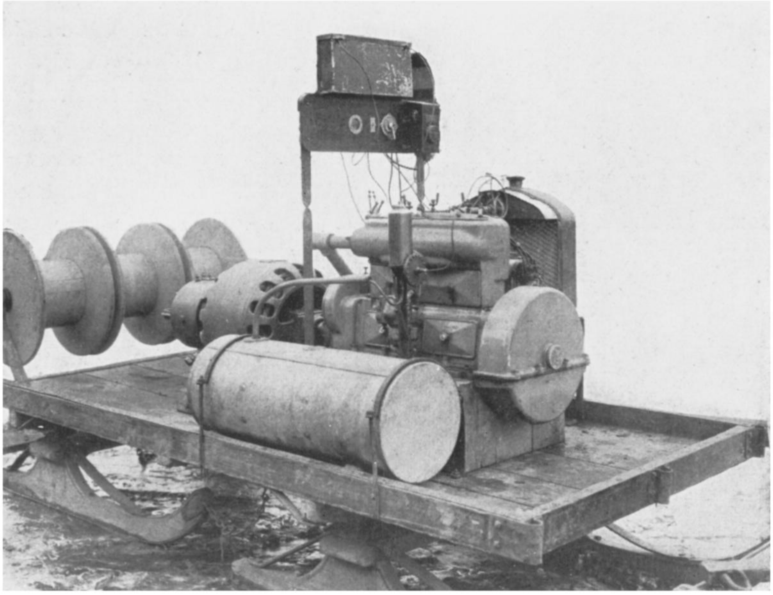

FIG. 3. GASOLINE-DRIVEN THAWING OUTFIT

Last winter two self-contained generating units, figure 3, were built, consisting of gasoline motors and specially designed generators, which have proved successful and much more convenient and rapid in actual service than the former outfits, as well as considerably less expensive.

The following figures for the past ten years show the extent and variation of the frost troubles in the distribution system.

YEAR	TOTAL NUMBER OF SERVICES	NUMBER OF SERVICES FROZEN	TOTAL NUMBER OF HYDRANTS	NUMBER OF HYDRANTS FROZEN
1910–11	37,705	470		
1911–12	41,620	2,313		
1912–13	45,680	544		
1913–14	48,926	901	1,286	
1914–15	51,584	83	1,341	477
1915–16	52,242	476	1,367	850
1916–17	52,690	485	1,388	589
1917–18	52,960	2,686	1,402	1,528
1918–19	53,122	18	1,405	224
1919–20	53,532	2,671	1,406	955

In addition to the frost trouble in distribution system, there is occasionally some trouble with frazil ice at the intake. By constant vigilance, however, in preventing the accumulation of ice at the mouth of the intake, no serious trouble has been encountered for many years.

Method of fixing water rates. With only two unimportant exceptions, the company collects the water rates from the consumers throughout the territory it supplies. The annual rates are determined by the rental value of the properties supplied, as appears by the municipal valuation in force. Manufacturers and a few other classes of consumers have, under certain conditions, the right of supply by meter. In some districts provision has been made for a hydrant rental and throughout the system a small charge of 5 cents per sprinkler head for private fire protection is levied.

In 1891, when the franchises were obtained and the rates were fixed, the City of Montreal had water rates which were considered, principally by the newspapers, as high. The company gave considerable discounts on those rates and adopted the same basis. These discounts varied from 25 to 60 per cent, and were accepted for 25 years subject to a revision downwards at the end of that time.

During the past 25 years, the city rates have been made a sport of the municipal politicians and until lately were very much below the cost of the service. Recently, however, the ordinary city rates have been advanced 50 per cent and some special rates in a greater proportion. But even today the water rates of the city do not cover the cost. As against this condition, the Company has not been in a position to obtain an equitable adjustment of its rates, the principal obstacle being, of course, in the nature of its contracts. Naturally at the present rates, with expansion in building at a practical standstill and with ever increasing cost of labor and material, the going is hard.

Increasing rental valuations will, if realized in the valuation rolls, help matters somewhat.

The meter principle for private houses has never found much favor in this part of Canada. One of the difficulties would be the necessary winter waste to prevent freezing of private services from the street line to the houses, over which the company has no control.

The system best calculated to meet present day conditions for water works plants is undoubtedly cost plus a fixed return on capital.